I. *A Letter of Mr.* Joſeph Williamſon *Watchmaker, to the Publiſher, wherein he aſſerts his Right to the curious and uſeful Invention of making Clocks to keep Time with the Suns Apparent Motion.*

HAving been inform'd of a *French* Book lately publiſhed, wherein the Author ſpeaks of making Clocks to agree with the Sun's apparent Motion; and ſuppoſeth that it was a thing never thought of by any before himſelf: I was therefore willing by the advice of ſome of my Friends, to write this ſhort Account of what I have performed in that matter my ſelf.

And in the firſt place I muſt take notice of the Copy of a Letter in this Book, wrote by one *P. Kreſa* a *Jeſuit*, to one Mr *Williamſon*, Clockmaker to his *Imperial Majeſty*; of a Clock found in the late King *Charles* the *Second* of *Spain*'s Cabinet, about the Year 1699 or 1700. which ſheweth both equal and apparent Time according to the Tables of Equation; and which went 400 Days without winding up. This I am well ſatisfied is a Clock of my own making; for about ſix Years before that time, I made one for Mr. *Daniel Quare*, for whom I then wrought moſtly, which agrees with the Deſcription he gives of it, and went 400 Days as he ſaith. This Clock Mr. *Daniel Quare* ſold, ſoon after it was made, to go to the ſaid King *Charles* the *Second* of *Spain*: and it was made ſo that if the *Pendulum* was adjuſted to the Sun's mean Motion, the Hands would ſhew Equal Time on two fixed Circles, on one the Hour, and on the other the Minute. But there were other two moveable Circles of the ſame kind, that moved

moved forwards and backwards, as the time of the Year required; on which the ſame Hands ſhewed Apparent Time likewiſe, according to the Equation Tables. This Method the Author owns he knew of, and applyed the ſame Motion to Pocket Watches 12 or 14 Years ago, which I confeſs I never did; being well ſatisfied that Watches with Springs and Ballances are very unfit to ſhew the minute difference, as it increaſeth and decreaſeth, between equal and apparent Time.

Soon after this Clock was ſent to *Spain*, I made others for Mr. *Quare* which ſhewed Apparent Time by lengthning and ſhortning the *Pendulum*, in lifting it up and letting it down again, by a Rowler ſomewhat in the form of an *Ellipſis*, through a ſlit in a piece of Braſs, which the Spring at the Top of the Pendulum went through. By this means every vibration of the *Pendulum* would agree to a Second of Time of the Suns apparent Motion; that Rowler which lifted up the *Pendulum*, and let it down again, being continually moving about all the Year; ſo that it may ſeem very ſtrange that this Author never heard of it, ſo many Years after they were made: For one of thoſe, and not the firſt, made with the riſing and ſetting of the Sun, Mr. *Quare* ſold to the late King *William*, and it was ſet up at *Hampton-Court* in his Life time, where it hath been ever ſince. This contrivance of lengthning and ſhortning the *Pendulum*, I thought of ſeveral Years before I made any of them. Since then I have made others for Mr. *Quare* likewiſe, which ſhewed the difference between equal and apparent Time according to the Equation Tables, by a Hand moving both ways from the top of a Circle; on one ſide ſhewing how much a Clock keeping equal Time ought to be faſter than the Sun, on the other ſide how much ſlower.

But

But theſe Clocks that I then made to agree with the Sun's Apparent Time, were done according to the Equation Tables, which I found not to agree very exactly with the Sun's apparent Motion: neither can any other be made to keep equal Time that will gain and loſe all the Year agreeable to the ſaid Tables: for though the Tables themſelves may be true, yet ſome difference in Motion does proceed, in both ſorts of Clocks, from Cold and Heat altering the length of their *Pendulums*. This difference by ſome Obſervations I have made, I ſuppoſe to be about the $\frac{1}{100}$ part of an Inch in the length of a *Pendulum* vibrating Seconds, which will alter the Motion of the Clock about 12 Seconds in 24 Hours. But to make my Clocks made for keeping Apparent Time to go as exact as poſſible, I made a Table my ſelf by Obſervation: For obſerving the Sun, as often as it was to be ſeen, when it came on the Meridian, for ſeveral Years together, always ſetting down the Difference between its coming to the Meridian and the Time by a Clock I had adjuſted as well as I could to equal Time, and always taking notice how much my Equal-Time Clock gain'd or loſt at the end of every Year, I compleated my Table in the Year 1711. Since then I have made a conſiderable many of theſe Clocks, ſeveral of which I ſold to Perſons of great Note and Ingenuity; and in particular one I made about five or ſix Years ſince for the Right Honourable the Lord *Parker*, at preſent Lord High Chancellor of *Great Britain*; and all of them have given good content to thoſe that bought them. So that I think I may juſtly claim the greateſt right to this contrivance of making Clocks to go with Apparent Time; and I have never yet heard of any ſuch Clock ſold in *England*, but what was of my own making, though I have made of them ſo long.